ABSTRACTS

KEYNOTE PRESENTATIONS

CONSERVATION TILLAGE AND ITS EFFECTS ON WEED ECOLOGY AND MANAGEMENT WITH A SPECIAL EMPHASIS ON HERBICIDE RESISTANCE AND SUSTAINABLE CROP PRODUCTION

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The mechanical manipulation of the soil allowed many societies to transition away from hunting and gathering as their primary source of acquiring food. The benefits of tillage (i.e. softening the seed bed, the release of soil nutrients, incorporation of amendments) have, however, been eclipsed by the damages (i.e. compaction and crusting, erodibility) that agricultural intensification precipitated. In North America, the adverse consequences of tillage were best high-lighted by the development of 'dust bowls' in the Midwestern United States (US) during the early 20th century.

One constraint that has historically impeded the adoption of reduced tillage systems has been growers' abilities to control weeds without significant soil disturbance. The discovery and commercialization of synthetic herbicides did, however, free many from the (often laborious) task of physical weed control, helping to usher in a modern era of conservation agriculture. Nevertheless, this does not suggest that the need for weed management has since been minimized. Weeds are highly adaptable organisms and the scientific literature is filled with evidence describing weed shifts in response to changes in tillage and other crop production practices associated with conservation agriculture. Growers, extension personnel, and research scientists, alike, have documented alterations to the vertical distribution of weed seeds, the frequency of weed seed predation and pathogenesis, and the density and diversity of the in-crop weed community.

The increased reliance on one or a few modes of action in many crop production systems has resulted in the development of herbicide resistances. The most concerning occurrences have been the evolution of glyphosate-resistant weeds in genetically-engineered, glyphosate-tolerant crops. This phenomenon has the potential to be devastating in crops, such as cotton, in which the adoption conservation tillage was facilitated by glyphosate's efficacy against difficult-to-control weed species. In recent years, this threat has been epitomized by the development glyphosate-resistant Palmer amaranth (*Amaranthus palmeri)* in the Southeastern, Midsouthern and Midwestern US.

Palmer amaranth, which can produce hundreds of thousands to a million seeds per plant, flourishes in reduced tillage systems as it emerges from very shallow burial depths. Plants that escape herbicide applications can quickly inundate the local seedbank with propagules. Emergency management measures such as increasing tillage intensity or engaging in infrequent mold-board plowing operations that can invert the soil profile have been recommended to reduce surface seedbank densities. In an effort to preserve conservation agriculture, numerous alternative strategies are being implemented to control Palmer amaranth in cotton including: adopting more diverse crop rotations; integrating high residue cover crops into cropping sequences; delaying planting; using alternate herbicide chemistries, overlapping soil-applied productsas well as improving residual activation and efficacy in non-irrigated systems; increasing post-harvest and fallow weed control measures; aggressive handweeding; and committing to intensive scouting operations.

A return to regular tillage operations could undo many of the improvements (i.e. reduced soil erosion, improved moisture holding capacity, improved soil and water quality), that growers had achieved following the adoption of glyphosate-tolerant cotton. Recent reports out of the Southeastern US indicates that these suggestions have been successful at combatting Palmer amaranth. Glyphosate may have helped to bring reduced-tillage cotton production to many states, such as Georgia, however, the development of glyphosate-resistant Palmer amaranth is not, necessarily, the assured end to conservation agriculture that it once was.

A GLIMPSE INTO THE PAST, PRESENT AND FUTURE TRENDS OF SOIL SCIENCE

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A revisit to the trends of soil science is justified by the theme of the congress: A nation embracing agriculture, ensures its future. Soil is a natural resource used inter alia for food production which in turn lead to degradation of this resource base. From this perspective it is good for soil scientists to look back and reflect on what has been achieved, how it was done and whether anything can be learned from the past. There is no doubt that is a respectable activity but it will not yield scientific breakthroughs. If soil scientists want to stay in business it is healthier to look forward and contribute to global challenges.

The development of soil science from 10 000 years ago until the 20th century will be discussed firstly, with the emphasis on soil chemistry, soil physics and soil biology, as well as pedology (Yaalon, 1997). During the last two centuries of this period some highlights were Way's establishment of the capacity of soil to adsorb and exchange cations, Darcy's approach towards flow of water through soil as a function of a hydraulic head, Kononova's fractionation of humus in soluble and insoluble fractions, and Dokuchaev's recognition of the soil profile, genetic horizons and soil-forming factors.

Then stock will be taken of the status of soil science in the late 1900s based on an IUSS survey where 55 soil scientists from 28 countries shared their views (Hartemink, 2006). This survey pointed out that vast soil scientific knowledge was generated which culminated in a number of encyclopedias. These encyclopedias were put together by well-known retired soil scientists. The question was asked rightly whether these encyclopedias mark the end of an era, and the beginning of a new one.

Lastly, the outcome of a SSSA initiative to prioritize research for the 21st century, the 25 top-ranked research questions from 140 submitted candidate questions within five predetermined thematic areas will be dealt with (Adewopo et al., 2014). The anticipation with this list of priority research questions is that it will aid soil scientists to align their research with existing knowledge gaps, which will advance knowledge frontiers to address pertinent social, ecological and economic challenges.

Soil science contributed over millenniums much to humankind as we know it today. This contribution will continue and expand without doubt in future.

REFERENCES

Yaalon DH. 1997. History of soil science in context: International perspective. Advances in Geoecology 29: 1-13.

Hartemink AE. 2006. Epilogue. In: Hartemink AE (ed). The future of soil science. IUSS, Wageningen, The Netherlands. pp 161-165.

Adewopo JB et al. 2014. Top-ranked priority research questions for soil science in the 21st century. Soil Science Society of America Journal 78: 337-347.

"WHITHER THE WEATHER?" OR, "WHEATHER WE WITHER?" PEEPING THROUGH THE LOOKING GLASS INTO A CLIMATE CHANGED WORLD

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Climate change is real and will become even more of a reality in years to come. We have just experienced the globally hottest decade on record, the hottest year on record and almost every single month in the past year has been the hottest ever, globally and in many parts of South Africa.

The agriculture sector is one of the most impacted by climate change. This is not so much because of the "push" factor of higher average temperatures or changes in mean annual rainfall, but rather because of the "pulse" factor of, for example, lower chill units, high critical threshold temperatures for different crops being exceeded more frequently, or more heat stress days for dairy cattle, as well as projected increases in year-to-year variability of temperature and rainfall.

So, "wither the weather?" In the presentation projections into future weather related issues in agriculture will be given for South Africa, including anticipated changes in optimum growing areas of crops and changing yields. To the question on "whether we wither", the presentation uses our present state of knowledge to assess to what extent we are prepared for a warmer future, how we can adapt in the various components making up the agriculture sector and what our competitive advantages and disadvantages are in South Africa.

CONSERVATION AND CONVENTIONAL AGRICULTURE: A COMPARATIVE ANALYSIS FOCUSSING ON DRYLAND MAIZE PRODUCTION

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Here we ask: what is the financial and economic viability of commercial dry-land maize production under both conventional (CV) and conservation agricultural (CA) systems. To answer this question we use a system dynamics (SD) to model the transition from CV to CA systems accounting for both private and societal costs in four maize producing regions in South Africa. The four regions mentioned are the four main maize production areas namely Western Free State (WFS), Eastern Free State (EFS), KwaZulu-Natal (KZN) and North West (NW). The simulation period was 20 years. Four region-framed production and environmental sub-models were constructed that make provision for the unique farming characteristics of both CV and CA systems in the studied regions.

Two ways have been used to model the transition from CV to CA systems. First by including the relationships between soil organic matter (SOM), soil organic carbon (SOC) and available water holding capacity (AWHC), to inform incremental changes in yield and carbon build-up gradually over a 20-year period to achieve the targeted yield profile. Second, as a result of the transition from CV to CA, a gradual reduction in the cost of production over a 10-year period.

The results indicate a considerable gain in the net present value, both in terms of private and social benefits, for CA in all four regions, but more so in the EFS and WFS. This is contrasted against, with the exception of KZN, a strong decline in the net present value of CV dryland maize production over the period in all the other regions – signalling the potential end of many farming operations. Should this be the case, the implications for both national and food security is considerable.

The above does imply that an agricultural sector that embraces its soils, embraces its future.